

INTELLIGENT PATH-CACHING AND QUERY OPTIMIZATION

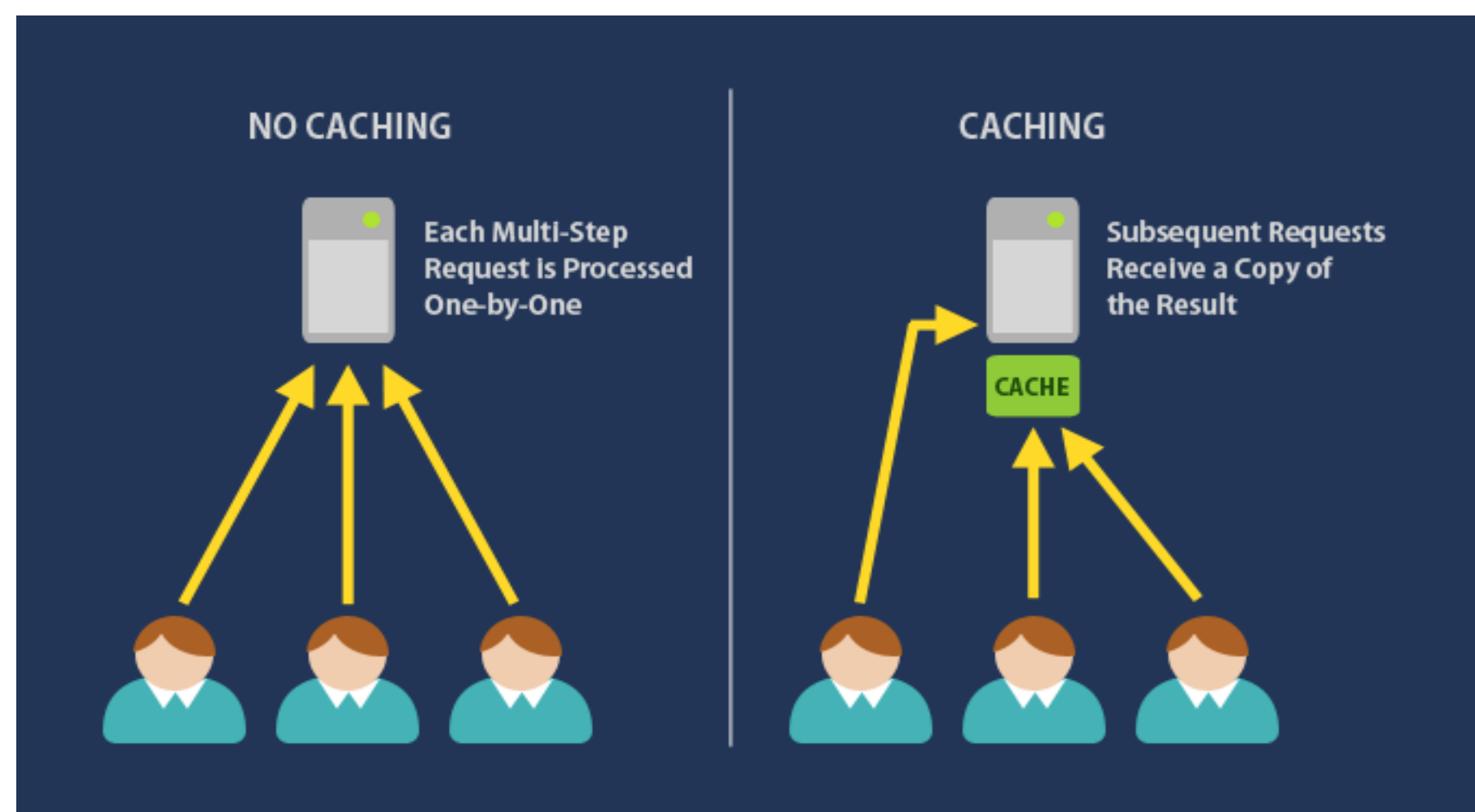
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1 Introduction

Path planning, a fundamental function of road network navigation services, finds a route between the specified start location and destination. Due to unexpected traffic, sudden change in driving direction and discovery of new paths on map have made the task difficult. A timely updated dynamic cache can minimize both load and task difficulty on server and serve the user better.

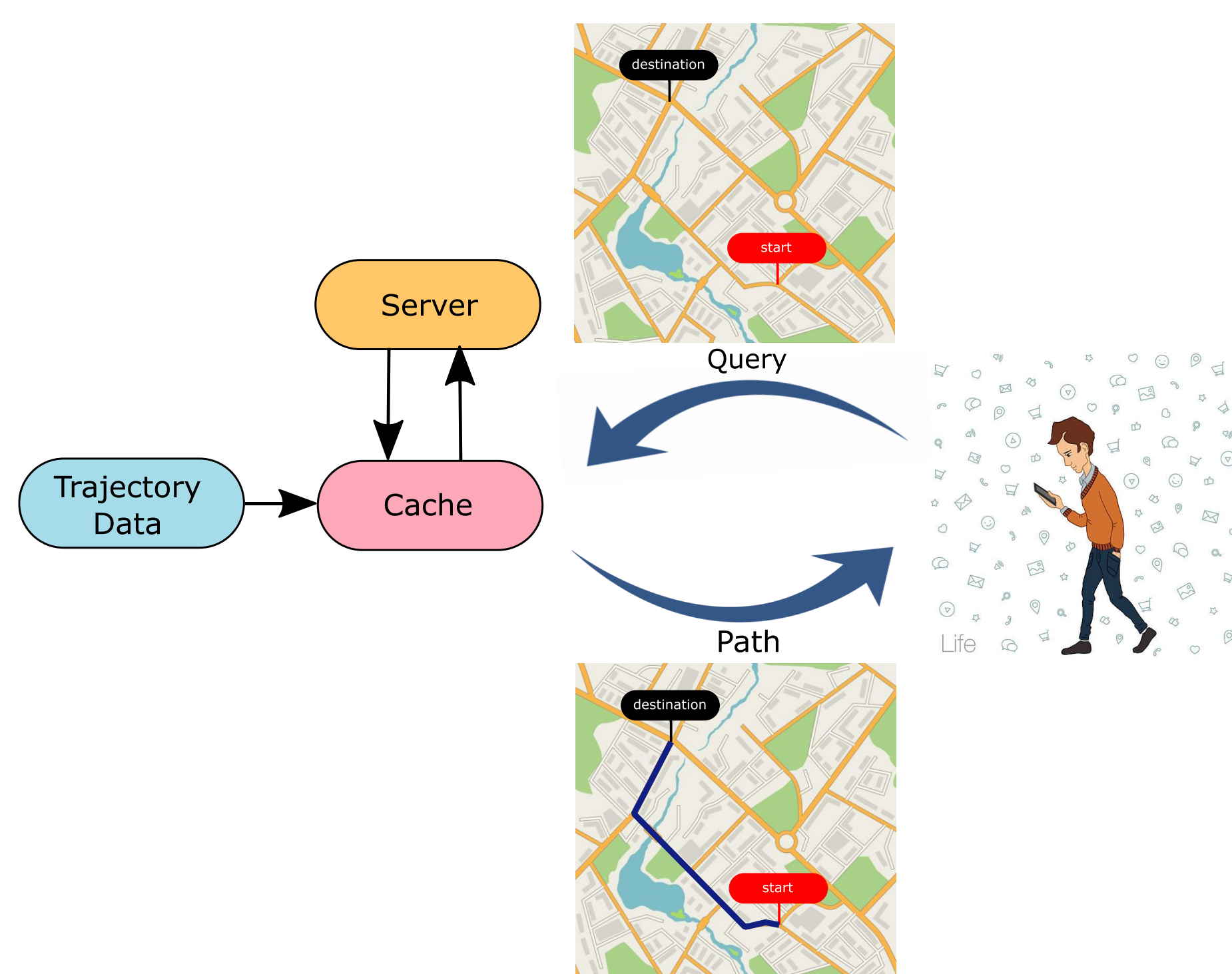


2 Motivation

- Shortest path is not always the best path
- Cache supported path planning
- Faster query response
- Introducing learning based path finding

3 Objective

- Path caching from trajectory data
- Predict path from cache in case of partial-hit



4 Problem Overview

- Continuously incoming trajectory data
- Build and update cache
- Respond to path-query with most popular path
- Build a learning-algorithm for path-prediction
- Path construction from predicted nodes
- Respond to path-query with most popular path

5 Challenges

- Repetition of same node in trajectory
- Limited cache size
- Popular path and node identification is hard
- Sub-path eviction can make the path divided into two or more paths, then the cache needs to be recalculated.

6 Problem Definition

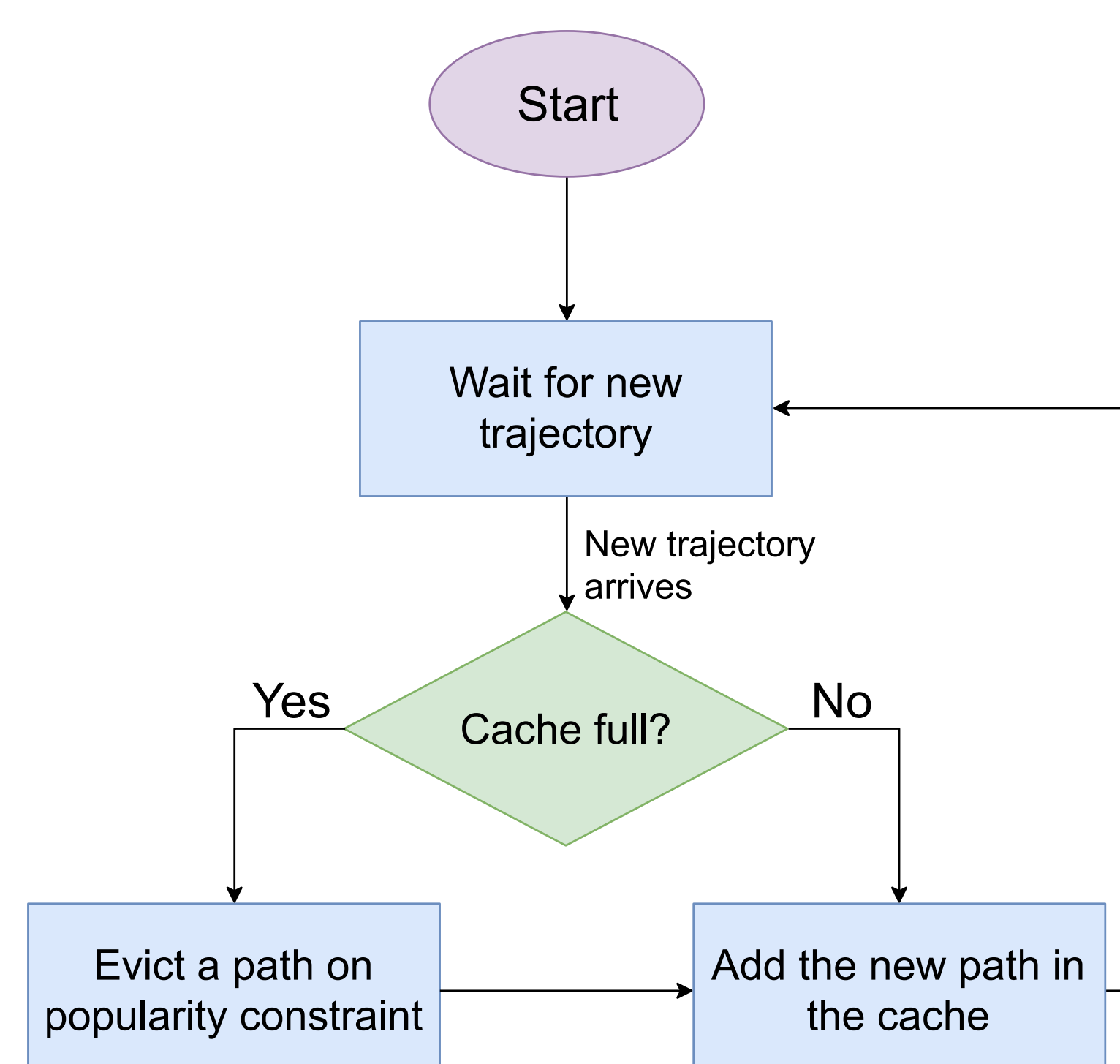
Given a cache budget β , a cache ψ is allowed to store a collection of paths such that $|\psi| \leq \beta$, where β refers to the maximum number of nodes allowed in the cache.

A trajectory τ is a time-ordered sequence of GPS-records capturing the movement of an object. We have continuous incoming trajectory data. Using these data, a cache ψ will be built considering budget-constraint.

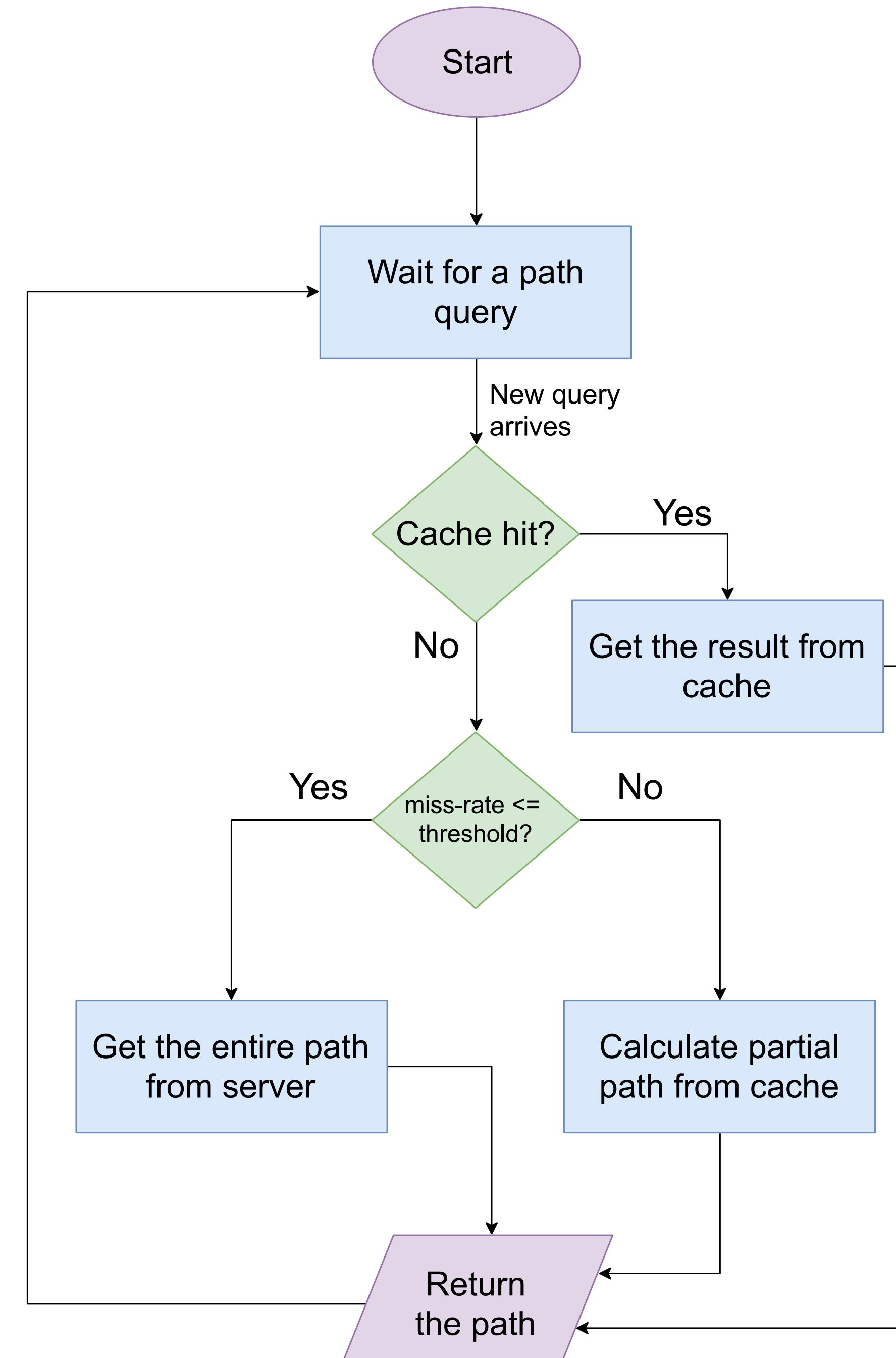
Inside the cache, a graph $G_\psi = (V_\psi, E_\psi)$ is built where each node $v_i \in V_\psi$ models a road-junction. Each edge $(v_i, v_j) \in E_\psi$ models a road-segment.

7 System FlowChart

- Cache-building Phase



- Query-Processing Phase



8 Approach

- Newly constructed path from trajectory data

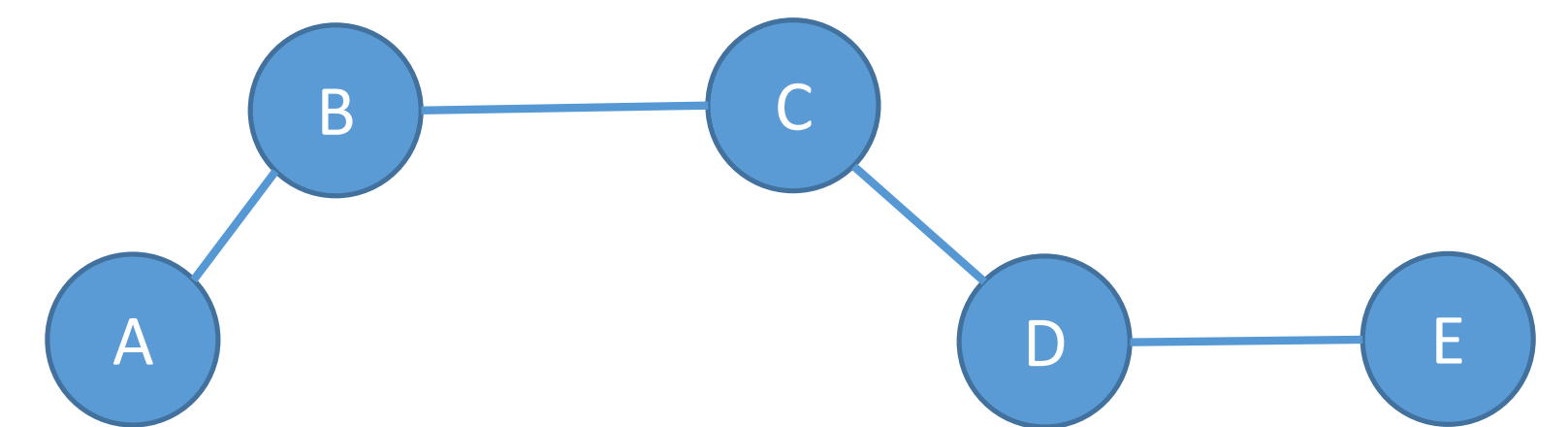


Figure: A route with five locations

- After updating, unnecessary nodes and edges are detected

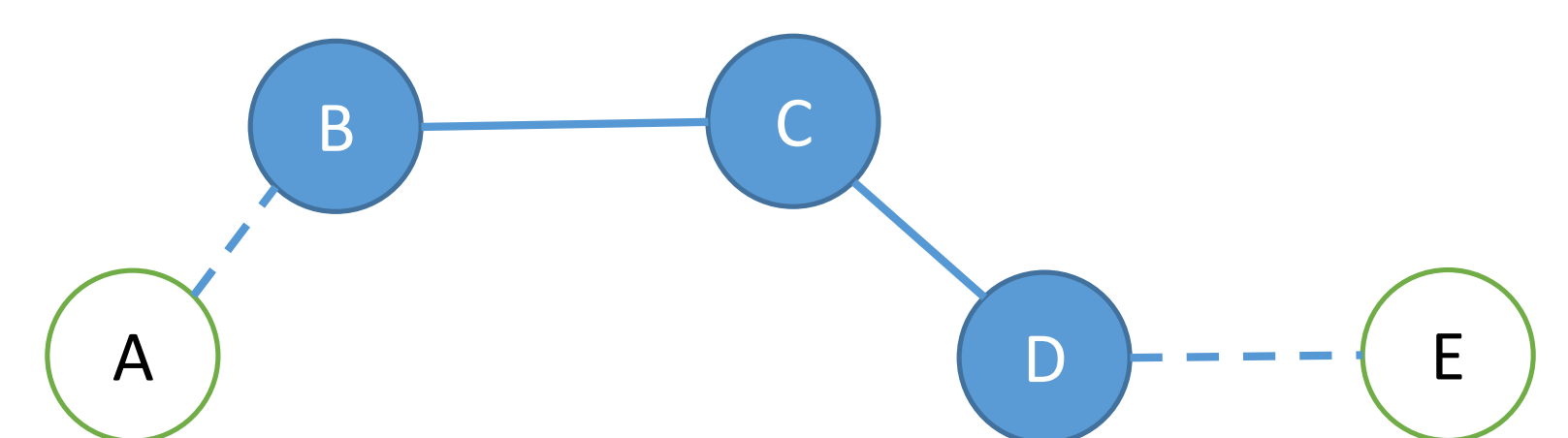


Figure: Updated Path

- After eviction, unnecessary edges get evicted

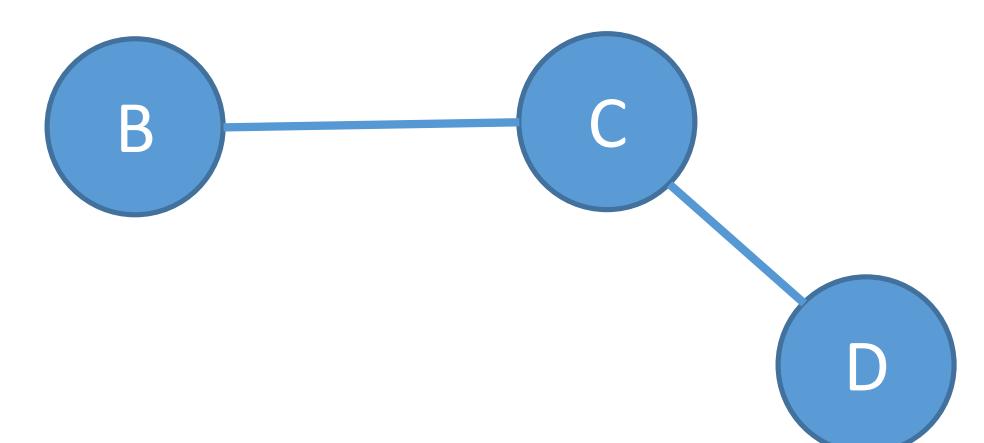


Figure: New Path

- We predict nodes then construct sub-path or full path from cache

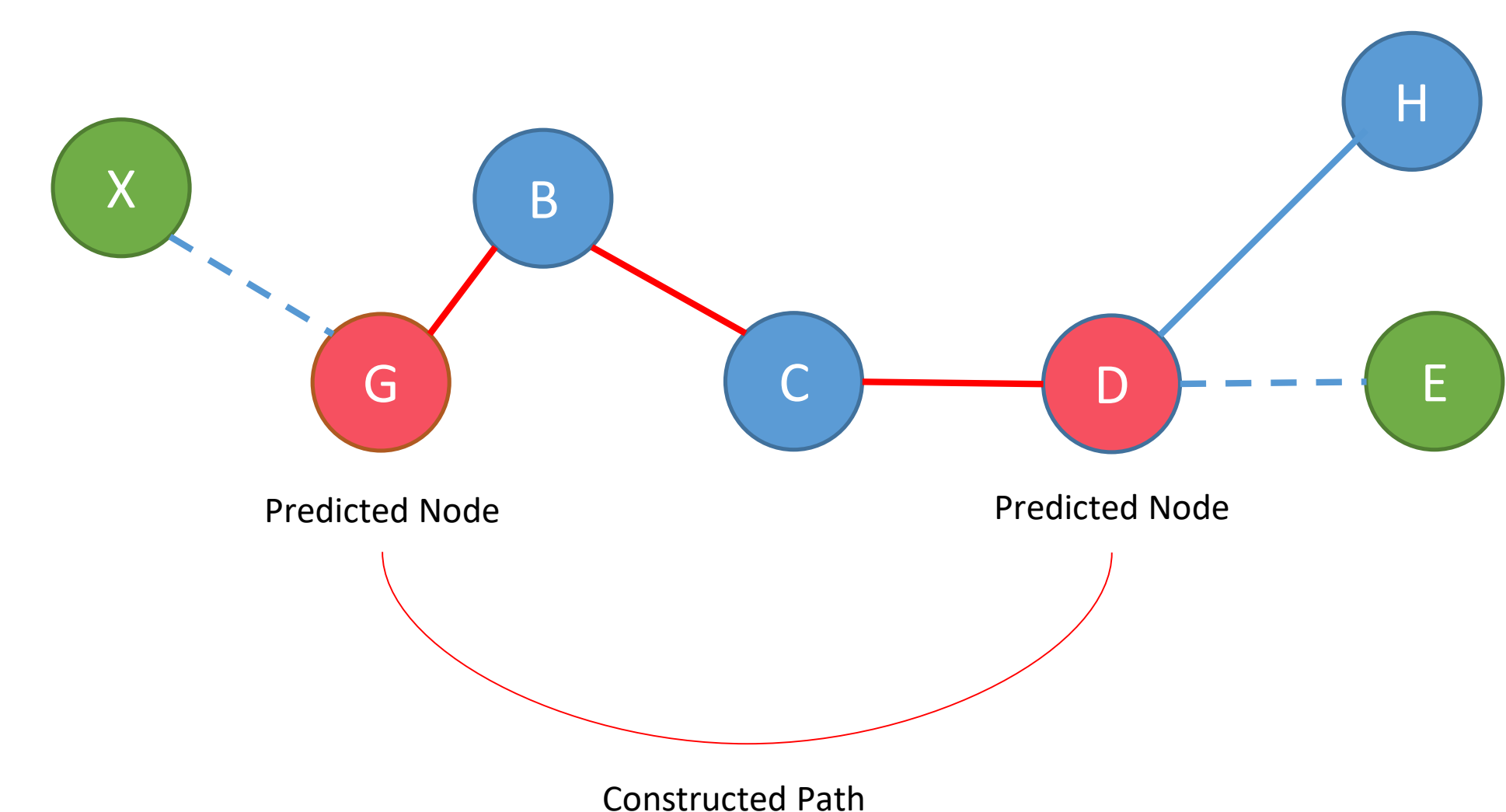


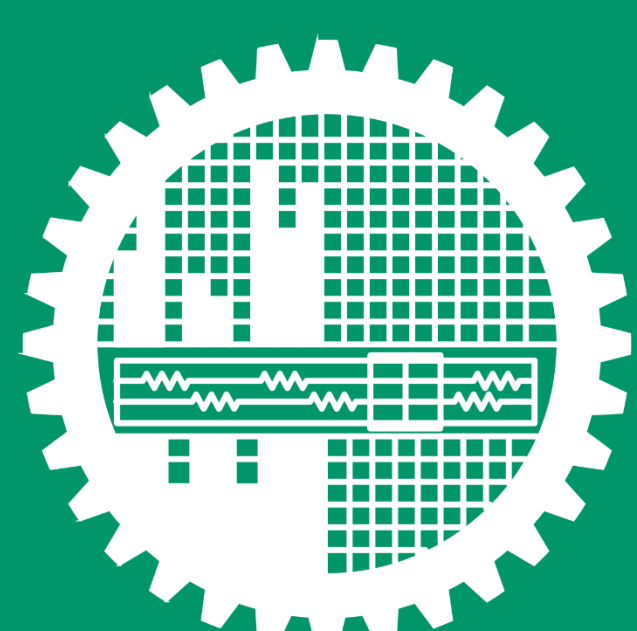
Figure: Node prediction and Path Construction

9 Future Plan

- Data processing and synthetic data generation
- Implementation of current model
- Performance measurement
- Prediction step can be upgraded
- Dynamic Graph CNN based learning can be used

10 Conclusion

- Performance depends on cached paths
- Time complexity depends on single path size
- Model struggles when destination cannot be reached from source in actual map
- Computation cost of cache management depends on interval between two cache update



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